



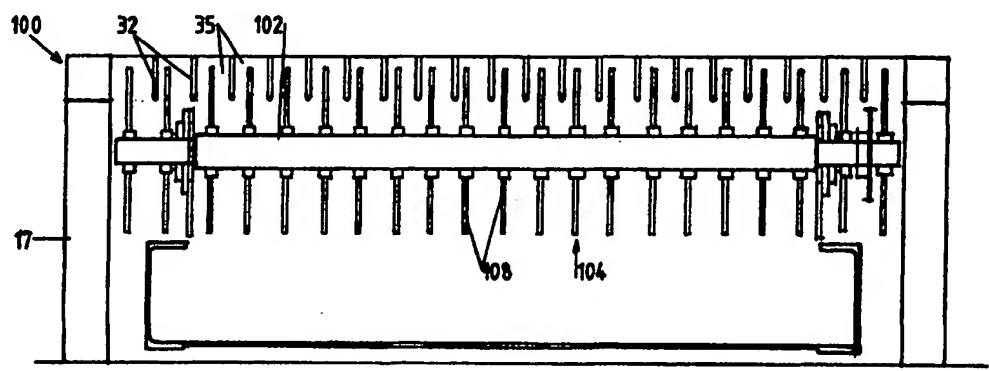
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(54) Title: TREATMENT OF WASTE MATERIALS



(57) Abstract

Apparatus suitable for use in the treatment of waste and/or organic materials which includes a main body having a treatment chamber therein having a base which when the apparatus is in a harvesting mode is arranged with a space therebelow. The base includes a plurality of generally parallel spaced apart support elements (32), the support elements being spaced apart at a distance sufficient to support the material within the chamber during the treatment process and enable extraction of the treated material through the spaces between the support elements during a harvesting process. There is also disclosed a harvesting device comprising a plurality of extraction elements (108) which are adapted to project through the spaces between the support elements to dislodge and extract the treated material through the base. The apparatus and harvesting device is particularly useful for removing worm castings in vermiculture.

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## TREATMENT OF WASTE MATERIALS

This invention relates generally to the treatment of waste materials and more particularly, though not exclusively, to the treatment of organic waste material such as for  
5 example, sewage sludge.

One particular application of the present invention relates to the treatment of organic waste materials by the use of worm species. This process is referred to hereinafter as vermiculture. Vermiculture is a process by which organic material is fed to a variety of  
10 worm species with the purpose of converting the organic material into increased worm biomass and vermicast. Vermicast is the excreter from worms and has use as a plant growth medium and soil conditioner. The worm biomass can be used for bait, animal feed and domestic and small composting systems. Worms have the ability to convert a wide range of organic material including sewage sludge provided the material is presented in an  
15 acceptable form. Vermiculture has been used in the past for the stabilisation of sewage sludge and other organic waste however, previous systems have been on a small scale and not be considered economically viable.

It is an object according to one aspect of the invention to provide apparatus suitable  
20 for use in vermiculture processing which enables large scale treatment of waste materials.

According to one aspect of the present invention there is provided apparatus suitable for use in the treatment of waste and/or organic materials, the apparatus including a main body having a treatment chamber therein which includes a base which when the apparatus is  
25 in a harvesting mode is arranged with a space therebelow, the base including a plurality of generally parallel spaced apart support elements, the support elements being spaced apart at a distance sufficient to support the material within the chamber during the treatment process and enable extraction of the treated material through the spaces between the support elements during a harvesting process.

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Preferably, the treatment chamber is at least partially bounded by a side wall and the support elements extend across the chamber between opposed sections of the side wall thereby defining the spaces between adjacent support elements.

5        Preferably, the base includes openings at the opposed sections of the side wall, each opening being associated with and generally aligned with a respective one of the spaces between adjacent support elements, the openings extending from the support elements in the direction of the side wall. It will be appreciated that the support elements may extend longitudinally of the main body.

10

Preferably, the space between the elements, centre to centre, is about from 50mm to 100mm, more preferably, from 70 or 80mm to 90mm and even more preferably from 85mm to 90mm.

15        The support elements may be in the form of elongated bars or rods which may be about 12mm in cross-sectional dimension. The support elements are preferably of formed metal and more preferably steel, such as for example, 500mpa yield strength steel.

In one preferred form of the invention, the support elements are in the form of  
20 substantially U-shaped rods or bars, the spaces between the uprightly directed arms of each U-shaped element defining the openings referred to earlier.

The main body may be in the form of a generally box like structure which is preferably of a general rectangularly or square shape when viewed in plan and has an open  
25 top. The apparatus may include a plurality of such structures in the form of modular units which can be arranged side by side. The support bars may extend laterally across the main body or extend longitudinally with the support bars in each modular unit being substantially aligned. In one preferred form, the main body may be carried on support legs so that the base thereof is raised above the ground or other support surface to define the space below the  
30 base. The side walls may, for example, be formed of a mesh material or be solid. The

apparatus may further include a spray assembly disposed above or to the side of the main body for selective spraying of the waste material within the treatment chamber. There may further be provided covers or a roof structure which can overlie the main body.

5        According to another preferred form of the invention, the main body forms a unit and the apparatus includes a plurality of units disposed in spaced apart planes one above the other. Preferably, there is a plurality of units disposed in each plane.

In this multi-tier form of the invention, the apparatus may include a support frame  
10 which includes one or more support columns. In one arrangement, each unit may be mounted to the or each support column in cantilevered fashion. In another arrangement, each unit may be mounted to at least two support columns at opposite ends thereof. Preferably, there is further provided a track assembly operatively connected to the support frame and being adapted to receive a harvesting device thereon.

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According to another embodiment the main body is in the form of a basket unit there being provided a plurality of units disposed one above the other. The apparatus further includes a mobile platform which is movable into a position whereby one of the basket units can be transferred onto the platform, the platform being movable to a position where the  
( 20 material within the basket can be harvested.

The apparatus of the present invention enables a continuous treatment and harvesting process to be effected. Waste material is fed to the treatment chamber through the open top. The upper section of the chamber forms a feed zone and the intermediate section of the  
25 chamber forms a treatment zone and the lower section forms a harvesting zone. The worms within the chamber progressively stabilise the material. The space beneath the base forms a harvest collecting zone, the material from the chamber being extracted through the base.

A second aspect of the present invention is related to a harvesting device which is  
30 suitable for use with the apparatus described above. Yet another aspect of the present

invention relates to components suitable for use in the harvesting apparatus.

According to another aspect of the present invention there is provided a harvesting device which is suitable for use with the treatment apparatus described above. The  
5 harvesting device includes a carriage which is adapted to move within the space below the base of the main body and in a direction generally parallel with the support elements of the base, and a harvesting tool which includes a plurality of extraction elements which project outwardly, the arrangement being such that when in use the extraction elements are adapted to extend through the spaces between the support elements into the treatment chamber so as  
10 to dislodge and extract the material through the base.

In one preferred embodiment, the tool is mounted for rotation on the carriage about an axis of rotation which extends transversely.

15 In one preferred form, the tool includes an elongated rotor body mounted for rotation about its longitudinal axis. The rotor body may be generally circular in cross section and may be in the form of a cylinder or drum. Preferably, the extraction elements are arranged to extend generally radially of the outer surface of the rotor body. By radially is meant that the extraction elements project outwardly from the outer surface of the rotor body. The  
20 elements do not necessarily extend exactly radially in the mathematical sense and may for example, be inclined to the true radial axis.

In one form of the invention, the extraction elements comprise a series of blades each having a radially projecting arm section and a laterally extending blade section at the free end  
25 of each arm. The blade section may be dimensioned so that it is adapted to fit between the openings between adjacent support elements in the base of the apparatus.

In another form of the invention, the extraction element may comprise tines which extend generally radially of the outer surface of the rotor element of the tool.

In yet another form of the invention, the extraction elements may include a plurality of blades or tines at least some having associated therewith a radially extending brush element.

5       The harvesting tool need not necessarily be rotatable. For example, the tool may include a plurality of extraction elements in the form of blades mounted on a frame or carriage which is adapted to move beneath the base of the main body with the blades extending into the treatment chamber via the spaces between the support elements in the base.

10       In one preferred form of the invention the extraction elements are arranged in one or more groups with the elements in the or each group being spaced apart from one another and extending across the rotor body from one side to the other. In one preferred form, two groups of elements are provided with associated elements in each group being opposite to one another. The elements in each group may be arranged in a spiral configuration from one  
15 side of the rotor body to the other.

The harvesting device may further include a base upon which the carriage can move. The base may include a track section for the carriage and wheels for moving the base between a harvesting position and a delivery position in which material collected is transferred to a  
20 storage location. In another form the carriage may be operatively mounted to the main body such as for example, on a rail for movement and/or guidance relative thereto.

Drive means may be provided for moving the carriage along the base. Such drive means may include a drive motor for driving a rope or cable drum which is operatively  
25 connected to the base.

In another preferred form, the tool includes a plurality of extraction elements in the form of blades mounted on a frame or carriage which is adapted to move beneath the base of the main body with the blades extending into the treatment chamber via the spaces between  
30 the support elements in the base.

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Preferably, the extraction elements are arranged in one or more groups with the elements in the or each group being spaced apart from one another and extending across the rotor body from one side to the other with two groups of elements are provided with associated elements in each group being opposite to one another, the elements in each group  
5 being arranged in a spiral configuration from one side of the rotor body to the other.

The device may further include a base upon which the carriage can move, the base including a track section for the carriage and wheels for moving the base between a harvesting position and a delivery position in which material collected is transferred to a  
10 storage location.

In yet another embodiment the carriage includes a frame which is adapted to be operatively connectable to a vehicle so that it can be raised or lowered and positioned within the space below the base of the main body of the apparatus, the tool including a plurality of  
15 blades at one end of the frame.

In yet another embodiment the device includes a main frame, wheels on the main frame which are adapted to run on tracks positioned relative to the main body of the apparatus so that the harvesting device can move beneath the base of the main body. The harvesting  
20 tool is operatively connected to the main frame, and a collecting receptacle is operatively connected to the main frame the receptacle having an open top side.

Preferably, the harvesting tool is disposed above the receptacle and movable relative thereto.  
25

There are several types of harvesting devices described. It will be appreciated that the various forms of harvesting tool can be used on the various types of harvesting device. For example, the type of device which is operatively connectable to a vehicle can have a rotatable cutter thereon.

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Preferably, the collecting receptacle includes a base which includes a conveyor means for discharging the harvested material from the receptacle. Preferably there is also provided a filling device for filling the treatment chamber, the filling device including a receptacle operatively connected to the main frame having an open top and a base, the base including  
5 conveying means for feeding material to a selected treatment chamber. It will be appreciated that the filling device may be completely separate from the harvesting device and operable totally independent thereof. This separate filling device may constitute a further distinct aspect of the invention.

10 Preferred embodiments of the invention will hereinafter be described with reference to the accompanying drawings, and in those drawings :

Figure 1 is a schematic view of apparatus according to the present invention;

15 Figure 2 is a diagram illustrating the various processes involved when the apparatus is in use;

Figure 3 is plan view of the base of the apparatus according to the present invention;

20 Figure 4 is a side elevation of the base shown in Figure 3;

Figure 5 is an end elevation of the base shown in Figures 3 and 4;

25 Figure 6 is a schematic side elevation of harvesting apparatus according to the present invention;

Figure 7 is a similar view to that of Figure 6 with the harvesting apparatus in a different position;

30 Figure 8 is a plan view of part of the harvesting apparatus;

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Figure 9 is plan view of another part of the harvesting apparatus;

Figure 10 is an end view of that part of the harvesting apparatus shown in Figure 8;

5 Figure 11 is an end view of the two parts of the apparatus shown in Figures 8 and 9;

Figure 12 is a plan view of harvesting apparatus according to another form of the present invention;

10 Figure 13 is a side elevation of the harvesting apparatus shown in Figure 12;

Figure 14 is an end view of the apparatus shown in Figure 12;

Figure 15 is a plan view of a carriage according to one form of the present invention;

15

Figure 16 is a side elevation of the carriage shown in Figure 15;

Figure 17 is a side elevation of harvesting tool according to one form of the present invention;

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Figure 18 is a side elevation of a harvesting tool according to another form of the present invention;

Figure 19 is a side elevation of a harvesting tool according to yet another form of the present invention; and

25

Figure 20 is a detail of part of the tool shown in Figure 19.

Figure 21 is a schematic perspective view of harvesting apparatus according to yet another embodiment of the present invention;

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Figures 22 and 23 are schematic views of the harvesting apparatus shown in Figure 21 when in use;

Figure 24 is a schematic side elevation of apparatus according to yet another embodiment of the present invention;

Figure 25 is a schematic detail of the apparatus shown in Figure 24;

Figure 26 is a schematic side elevation of apparatus according to yet another embodiment of the present invention;

Figure 27 is a schematic detail of the apparatus shown in Figure 26;

Figure 28 is a schematic end elevation of apparatus according to yet another embodiment of the present invention;

Figure 29 is a partial schematic side elevation of the apparatus shown in Figure 28;

Figure 30 is a plan view of the apparatus shown in Figures 28 and 29; and

Figure 31 is a schematic side elevation of yet another embodiment of harvesting apparatus according to the present invention.

Referring to Figures 1 to 5 of the drawings there is shown apparatus generally indicated at 10 which comprises a main body 12 in the form of a rectangular box shaped structure having mesh side walls 15 mounted to frame members 16. The main body 12 is supported on legs 17 so that it is spaced above the ground. There is further included supports 20 and a top bar 22 for supporting a spray pipe 19 (See Figure 2).

The main body 12 has a treatment chamber 25 therein with an open top 26 and a base

- 10 -

30. The treatment chamber is adapted to receive organic waste such as sewage sludge which is fed to the chamber via the open top and contains species of worms therein.

The base 30 includes a plurality of support elements 32 in the form of generally  
5 parallel U-shaped bars having arm portions 33 and a web portion 34. The arm portions 33 are welded to mounting plates 36 so as to form openings 35 therebetween. A cover or roof 18 may be provided over the top of the main body (see Figure 2).

The process is schematically illustrated in Figure 2. Organic waste such as sewage  
10 sludge is fed to the treatment chamber 25 within main body 12 via the open top 26. The treatment chamber contains worms which progressively stabilise the waste material. The upper section A of the chamber defines a feeding zone and the intermediate section B defines a treatment zone and the lower section C defines a harvesting zone. When the waste material has been stabilised it is harvested within the space below the base which defines an access or  
15 harvest collecting zone D, the material being extracted from the treatment chamber through the spaces between the support bars in the base.

Referring to, in particular, Figures 6 to 20 there is shown various embodiments of a harvesting device generally indicated at 50 which includes a base 60 having side rails which  
20 define a track 61, ground engaging wheels 64 and steering wheels 66, steering wheels being mounted on pivot arms 68 and arranged for actuation by piston cylinder 69. Alternatively, the wheels may be mounted on a telescopic leg.

The base 60 is movable between a harvesting position in which it is disposed beneath  
25 the main body 12 of the treatment apparatus and a delivery position in which harvested material which is collected on the base 60 can be transferred for example, to a transport conveyor 90. In the delivery position the steering wheels are raised by pivot arms 68 so that the end of the base 60 is disposed above the transport conveyor 90.

30 The base 60 includes a conveyor 78 which collects the harvested material thereon and

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transfers it to the transport conveyor 90. The base 60 further includes lateral locating wheels 65 which are mounted to pivot arms 67 which where actuated cause the wheels 65 to lift the base 60 and permit lateral movement thereof.

5 A carriage 80 is disposed on the base and includes track engaging wheels 82, a main body or frame 84, a tool mounting section 86 and drive motor for driving the carriage and a drive motor for driving a tool 100.

The carriage 80 is adapted to run along rails 61 of the base 60. The carriage 80  
10 includes a drive motor 88 mounted so as to drive rope drum 97. The rope or cable 98 on the rope drum is operatively connected to the ends of the base 60 so that rotation of the drum will cause movement of the carriage 80 along the rails in a forward or rearward direction

As best shown in Figures 17 to 20, the tool 100 is mounted for rotation on the  
15 carriage and drive by drive motor 95 through transmission 96 in the form of a chain and sprocket mechanism.

The tool generally indicated at a 100 includes a rotor section 102 having a plurality of extraction elements 104 thereon. In the embodiment of Figure 17, the extractions  
20 elements are in the form of blades 106. In the embodiment of Figure 18, the extractions elements are in the form of tines 108 and in the embodiment of Figures 19 and 20, the extraction elements include tines 108 and brushes 110.

In the harvesting operation the base 60 is disposed in the space beneath the main body  
25 12 with its rails 61 being generally parallel with material support elements 32 and with the extraction elements 104 of the tool 100 aligned with the openings 35 at the ends of the material support elements. Once the base 60 and carriage 80 are correctly positioned relative to the base of the main body 12 the carriage 80 is moved along the rails 61 with the tool 100 rotating. As the carriage 80 moves into the space beneath the main body 12 the extraction  
30 elements 104 pass through the openings 35 and into the treatment chamber in the spaces

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between the support elements 32. The extraction elements cause dislodgement of the treated material which falls through the base 30 of the main body 12 onto conveyor 78 on the base 60 of the harvesting device. The base 60 can then be withdrawn and positioned for transfer of the harvested material from conveyor 78 to transport conveyor 90.

5

A further embodiment of harvesting device according to the present invention is shown in Figures 21 to 23. The harvesting device generally indicated at 150 includes a main frame 160 comprising side members 162 and 163 and a mounting section 165. The mounting section is adapted to be secured to a vehicle 400 so that it can be moved forwards or backwards or be raised or lowered.

The device further includes a harvesting tool 200 at the forward end of the frame 160. The tool 200 includes a series of upwardly projecting extraction elements 204 in the form of blades 206. A scraper blade 207 projects downwardly from the frame 160.

15

In the harvesting operation the main frame 160 of the device is mounted to the vehicle and then positioned in the space beneath the main body 12 for movement generally parallel with material support elements 32 and with the extraction elements 204 of the tool 200 aligned with the openings 35 at the ends of the material support elements. Once the frame 160 is correctly positioned relative to the base of the main body 12 the frame is raised so that the elements 204 pass through the openings 35 and into the treatment chamber in the spaces between the support elements 32. The vehicle is then reversed and the extraction elements cause dislodgement of the treated material. Extraction may also be effected by forward movement of the vehicle. Furthermore, the elements 204 may be replaced by a rotatable extraction tool.

Referring to Figures 24 and 25 there is shown a multi-tiered system wherein the units are supported in different planes and in rows by a support frame 120 which includes a plurality of upright columns 122 and a series of platforms 124 arranged in cantilevered fashion on the columns. The platforms 124 may form part of the units or simply provide a

30

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support for the units. The support elements 32 of the base 30 project downwardly from the platforms 124. The platforms 124 are arranged in groups one above the other and there is a space between the units in each plane. A roof 128 covers the support frame 120. A series of laneways 129 are provided between the groups of units.

5

The system further includes a track assembly 126 associated with each platform 124 and includes a pair of tracks 127 in the form of channels for carrying a harvesting tool which may for example be of the type described with reference to Figure 31.

10 The system shown in Figures 26 and 27 is essentially the same as that described in Figures 24 and 25 and like reference numerals have been used to describe like parts. In this particular system however, each platform is supported between upright columns 122.

Referring to Figures 28 to 30 this also shows a multi-tiered system. This system  
15 relies on the units being large individual baskets 160. Each unit is relatively large and may be, for example, 6m long, 1.8m wide and 700mm deep. (The support elements 32 on the base 30 to run across the 1.8m width of the bed.) The sides of the basket are constructed to form a beam or truss able to span the 6m when fully loaded as described earlier. At the basket ends there are wheels similar to rail bogies which allow the basket to be pulled out  
20 from the support frame for feeding, monitoring, etc. The support frames include a tower / column structure that has rails at levels to allow the roll on and roll off these large baskets. These will be rolled onto and off a large platform 165 able to be raised and moved into position for each basket so that the basket on the platform can be transferred to a harvesting location.

25

The baskets can be stacked, for example, 5 high with 11 baskets in a row with the whole system having 4 rows of towers, two towers with two baskets across per level and the two outer towers having a single width of baskets. At the top of each of the towers a connecting member can be included to provide additional stability and can be used to provide  
30 support for the roof structure.

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Figure 31 illustrates a harvesting device which is suitable for use with the multi-tier systems described with reference to Figures 25 to 29. The harvesting device generally indicated at 350 includes a main frame 360 having wheels 303 thereon which are adapted to run on tracks 127 as shown in Figures 24 to 27. There are further provided two open topped  
5 receptacles 361 and 362 which are secured to and depend below the main frame 360. One of these receptacles 362 is used for collecting the harvested material and the other 361 is used for a filling operation.

Each receptacle has a conveyor 310 and 311 in the base thereof for discharging  
10 material from the respective receptacle. The conveyors 310 and 311 are driven by respective drive mechanisms 313 and 316.

The receptacle 361 which is used in the filling operation has associated therewith a rotatable flinging device 315 driven by drive mechanism 312. The device 313 is shown  
15 rotatable about a horizontal axis. It may also in another form be rotatable about a vertical axis. A rake 317 is provided for raking the material.

The device further includes a harvesting tool 306 which includes a rotatable member having tines thereon. The tool 306 is driven by drive 307 which causes rotation of the tool  
20 as well as movement relative to the receptacle 362 shown by the arrow. A height adjustment device 320 raised or lowers the tool 306 and a sensor 321 senses the level of the material within the receptacle. All systems are powered by power unit 308.

The tools used in each device shown may be interchangeable.

25

Finally, it is to be understood that various alterations, modifications and/or additions may be incorporated into the various constructions and arrangements of parts without departing from the spirit or ambit of the invention.



## CLAIMS :

1. Apparatus suitable for use in the treatment of waste and/or organic materials, the apparatus including a main body having a treatment chamber therein which includes a base  
5 which when the apparatus is in a harvesting mode is arranged with a space therebelow, the base including a plurality of generally parallel spaced apart support elements, the support elements being spaced apart at a distance sufficient to support the material within the chamber during the treatment process and enable extraction of the treated material through the spaces between the support elements during a harvesting process.  
10
2. Apparatus according to claim 1 wherein treatment chamber is at least partially bounded by a side wall and the support elements extend across the chamber between opposed sections of the side wall thereby defining the spaces between adjacent support elements.
- 15 3. Apparatus according to claim 2 wherein the base includes openings at the opposed sections of the side wall, each opening being associated with and generally aligned with a respective one of the spaces between adjacent support elements, the openings extending from the support elements in the direction of the side wall.
- 20 4. Apparatus according to claim 3 wherein the space between the elements, centre to centre, is about from 50mm to 100mm.
5. Apparatus according to any preceding claim wherein the support elements may be in the form of elongated bars or rods.  
25
6. Apparatus according to claim 5 wherein the support elements are in the form of substantially U-shaped rods or bars, the spaces between the uprightly directed arms of each U-shaped element defining the openings.
- 30 7. Apparatus according to claim 6 wherein the main body is in the form of a generally

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box like structure which is of a general rectangularly or square shape when viewed in plan and has an open top.

8. Apparatus according to claim 7 including a plurality of said modular units which can  
5 be arranged side by side.

9. Apparatus according to claim 8 wherein the support bars extend laterally across the main body or extend longitudinally with the support bars in each modular unit being substantially aligned.

10

10. Apparatus according to claim 9 wherein the main body is carried on support legs so that the base thereof is raised above the ground or other support surface to define the space below the base.

15 11. Apparatus according to claim 10 wherein the side walls may be formed of a mesh material.

12. Apparatus according to claim 11 wherein further including a spray assembly disposed above the main body for selective spraying of the waste material within the treatment  
20 chamber.

13. Apparatus according to claim 12 further including covers which overlie the main body.

25 14. Apparatus according to claim 1 wherein the main body forms a unit and the apparatus includes a plurality of units disposed in spaced apart planes one above the other.

15. Apparatus according to claim 14 wherein there is a plurality of units disposed in each plane.

30

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16. Apparatus according to claim 14 or claim 15 including a support frame which includes one or more support columns.

17. Apparatus according to claim 16 wherein each unit is mounted to the or each support  
5 column in cantilevered fashion.

18. Apparatus according to claim 16 wherein each unit is mounted to at least two support columns at opposite ends thereof.

10 19. Apparatus according to any one of claims 16 to 18 further including a track assembly operatively connected to the support frame and being adapted to receive the harvester thereon.

20. Apparatus according to claim 1 wherein the main body includes a basket unit there being provided a plurality of units disposed one above the other, the apparatus further  
15 including a mobile platform which is movable into a position whereby one of the basket units can be transferred into the platform, the platform being movable to a position where the material within the basket can be harvested.

21. A harvesting device which is suitable for use with the treatment apparatus according  
( 20 to claim 1, the harvesting device including a carriage which is adapted to move within the space below the base of the main body and in a direction generally parallel with the support elements of the base, and a harvesting tool which includes a plurality of extraction elements which project outwardly, the arrangement being such that when in use the extraction elements are adapted to extend through the spaces between the support elements into the treatment  
25 chamber so as to dislodge and extract the material through the base.

22. A harvesting device according to claim 21 wherein the tool is mounted for rotation on the carriage about an axis of rotation which extends transversely.

30 23. A harvesting device according to claim 22 wherein the tool includes an elongated rotor

body mounted for rotation about its longitudinal axis.

24. A harvesting device according to claim 23 wherein the rotor body is generally circular in cross section and in the form of a cylinder or drum.

5

25. A harvesting device according to claim 24 wherein the extraction elements are arranged to extend generally radially of the outer surface of the rotor body.

26. A harvesting device according to claim 25 wherein the extraction elements include a series of blades having a radially projecting arm section and a laterally extending blade section at the free end of each arm, the blade section being dimensioned so that it is adapted to fit between the openings between adjacent support elements in the base of the apparatus.

27. A harvesting device according to claim 26 wherein the extraction elements include tines which extend generally radially of the outer surface of the rotor element of the tool.

28. A harvesting device according to claim 26 wherein the extraction elements include a plurality of blades or tines at least some having associated therewith a radially extending brush element.

20

29. A harvesting device according to claim 21 wherein the tool includes a plurality of extraction elements in the form of blades mounted on a frame or carriage which is adapted to move beneath the base of the main body with the blades extending into the treatment chamber via the spaces between the support elements in the base.

25

30. A harvesting device according to claim 25 wherein the extraction elements are arranged in one or more groups with the elements in the or each group being spaced apart from one another and extending across the rotor body from one side to the other with two groups of elements are provided with associated elements in each group being opposite to one another, the elements in each group being arranged in a spiral configuration from one side

- 19 -

of the rotor body to the other.

31. A harvesting device according to claim 25 further including a base upon which the carriage can move, the base including a track section for the carriage and wheels for moving  
5 the base between a harvesting position and a delivery position in which material collected is transferred to a storage location.

32. A harvesting device according to claim 21 wherein the carriage includes a frame which is adapted to be operatively connected to a vehicle so that it can be raised or lowered  
10 and positioned within the space below the base of the main body of the apparatus, the tool including a plurality of blades at one end of the frame.

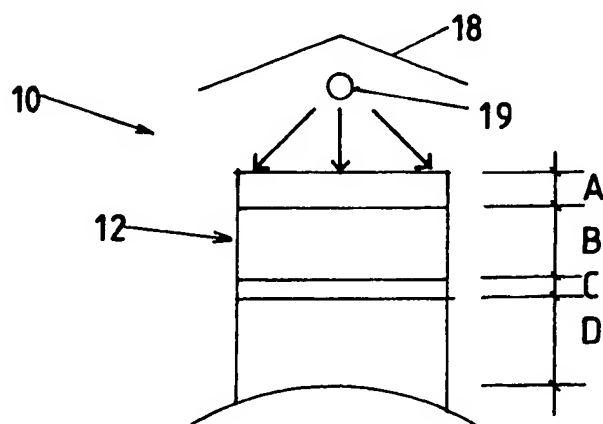
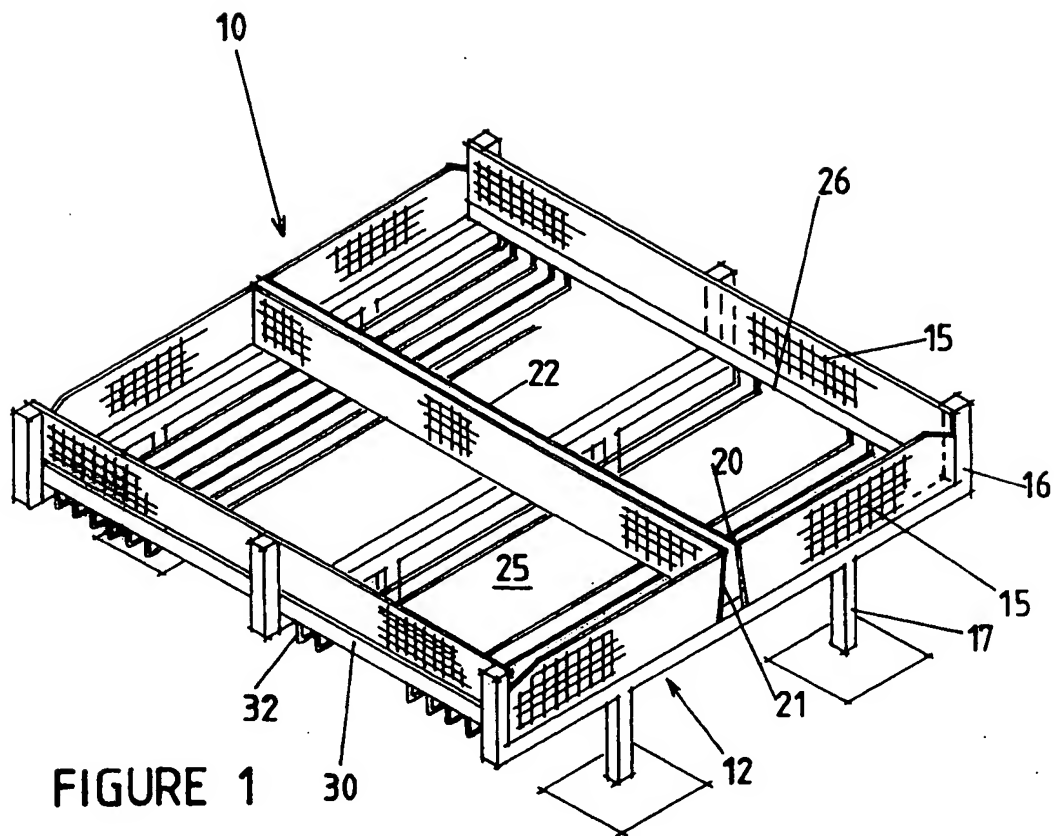
33. A harvesting device according to claim 21 including a main frame, wheels on the main frame which are adapted to run on tracks positioned relative to the main body of the apparatus  
15 relative to the main body of the apparatus so that the harvesting device can move beneath the base of the main body, the harvesting tool operatively connected to the main frame, and a collecting receptacle operatively connected to the main frame having an open top side.

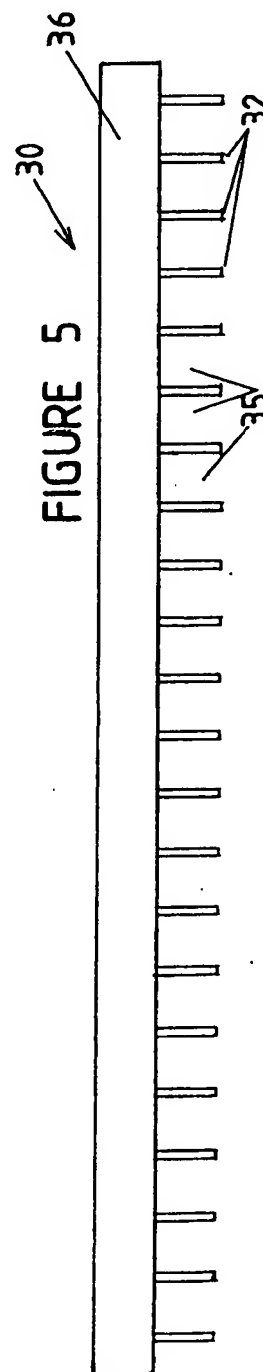
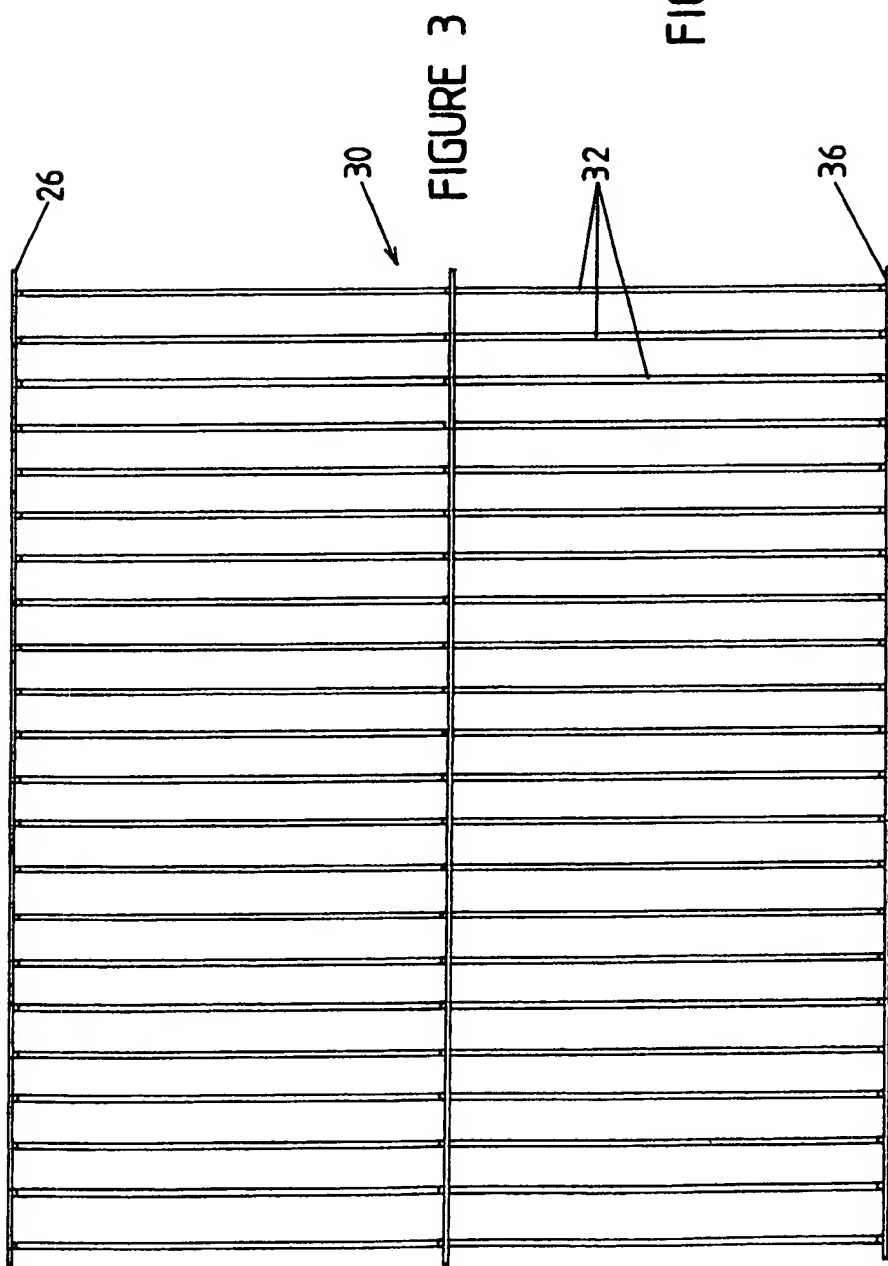
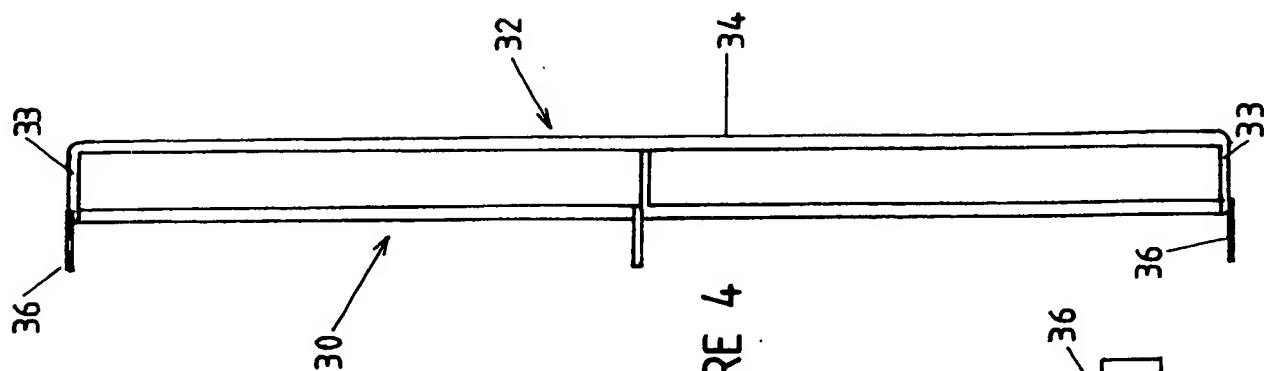
34. A harvesting device according to claim 33 wherein the harvesting tool is disposed  
20 above the receptacle and movable relative thereto.

35. A harvesting device according to claim 34 wherein the collecting receptacle includes a base which includes a conveyor means for discharging the harvested material from the receptacle.

25

36. A harvesting device according to claim 35 including a filling device for filling the treatment chamber, the filling device including a receptacle operatively connected to the main frame having an open top and a base, the base including conveying means for feeding material to a selected treatment chamber.





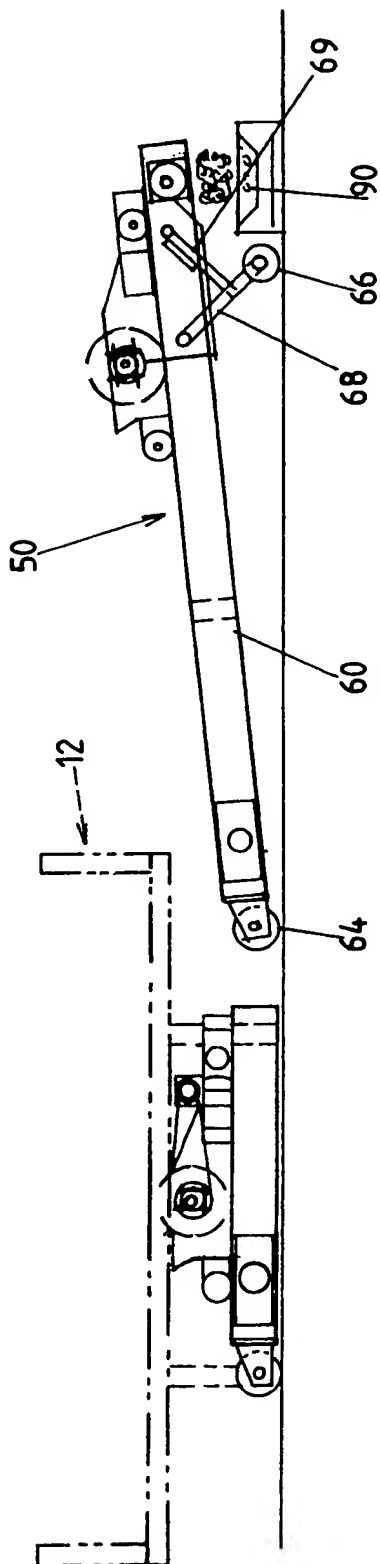


FIGURE 6

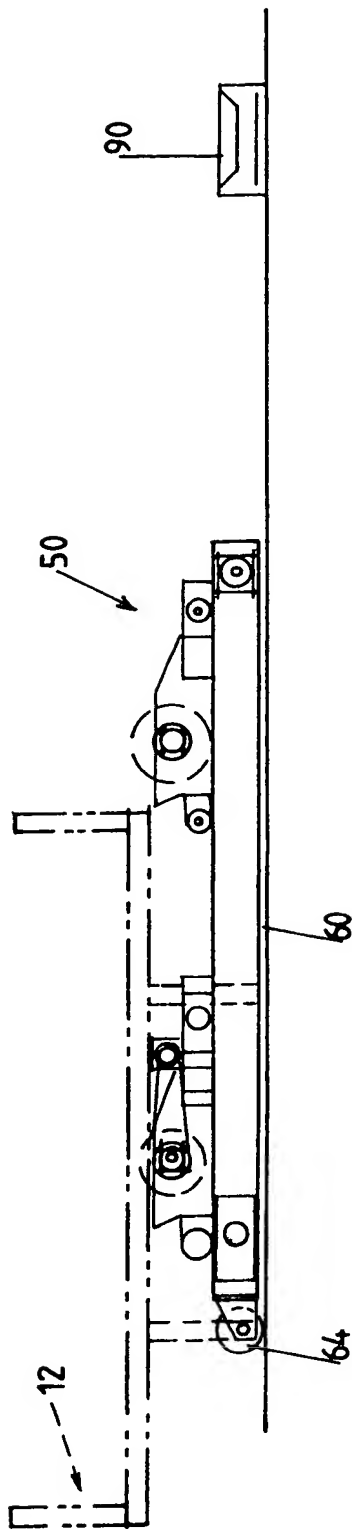


FIGURE 7



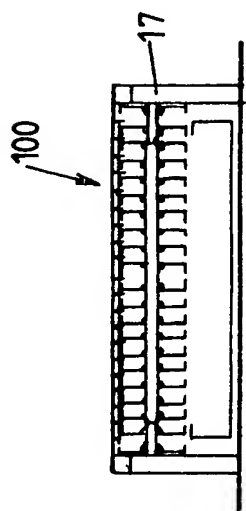


FIGURE 11

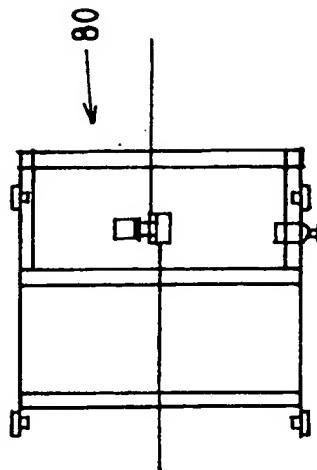


FIGURE 9

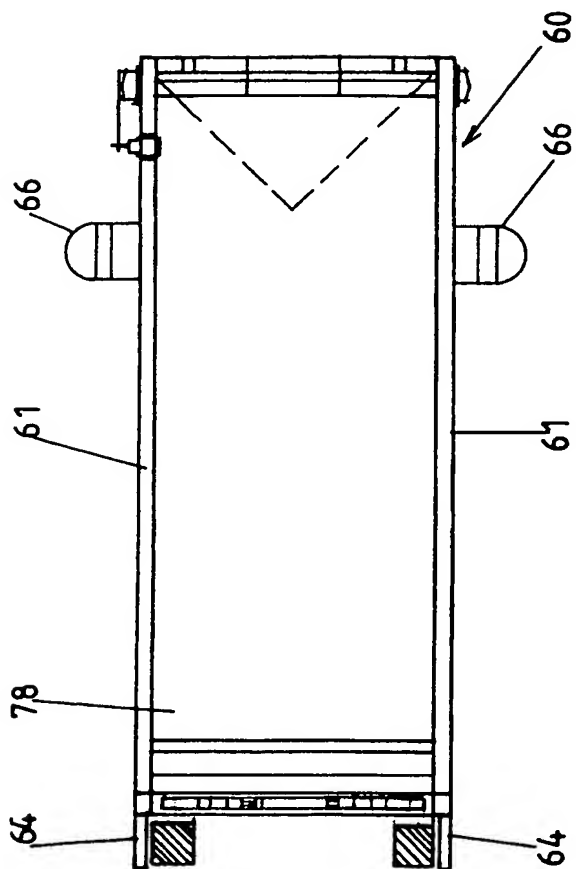


FIGURE 8

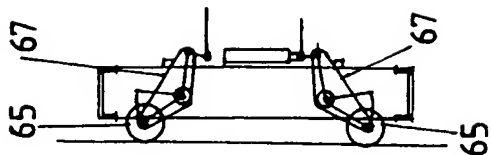
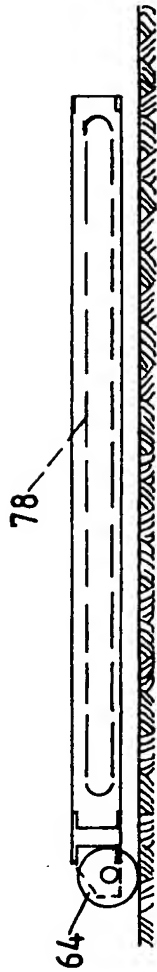
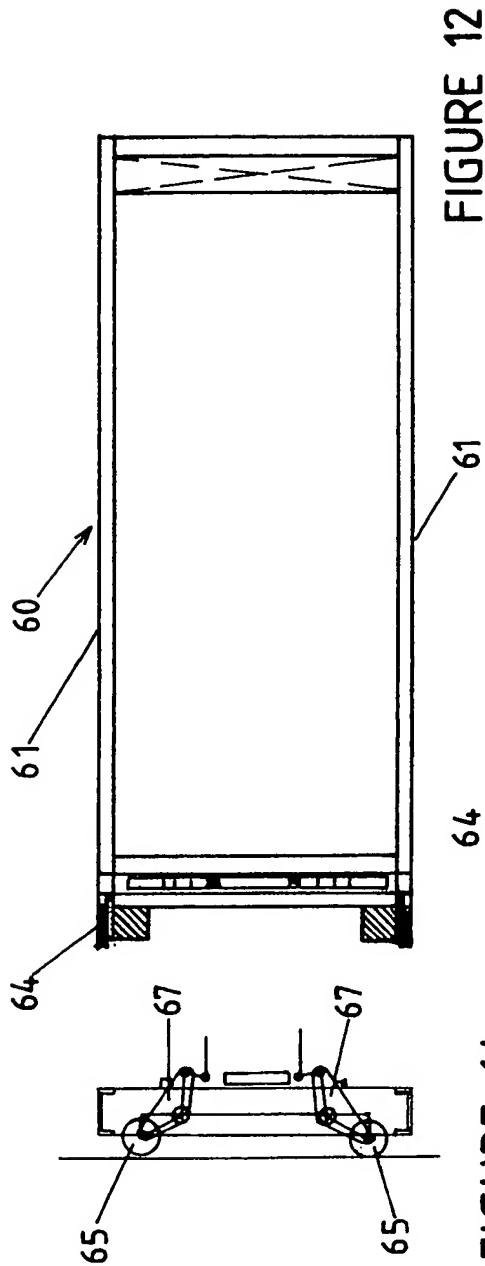
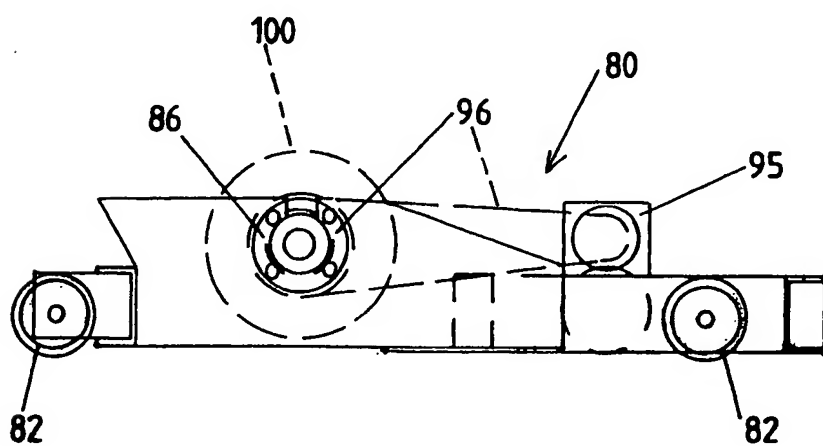
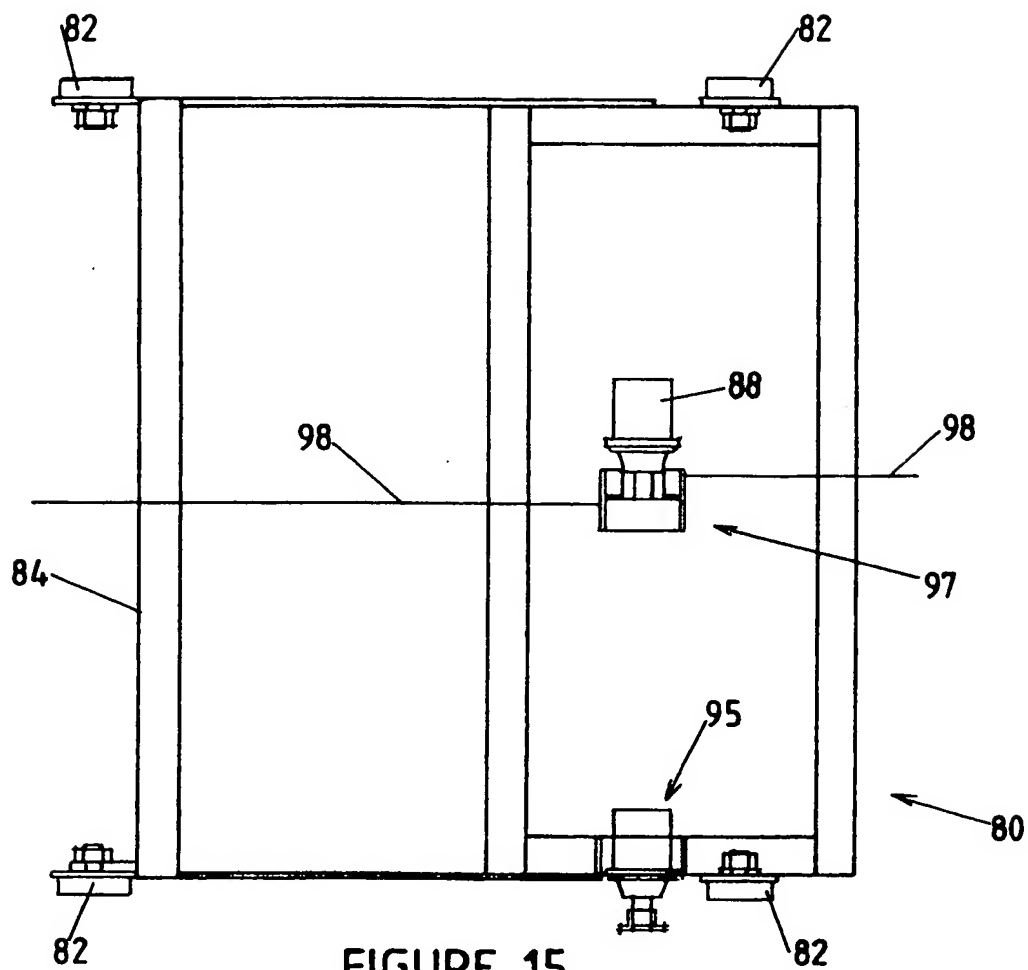
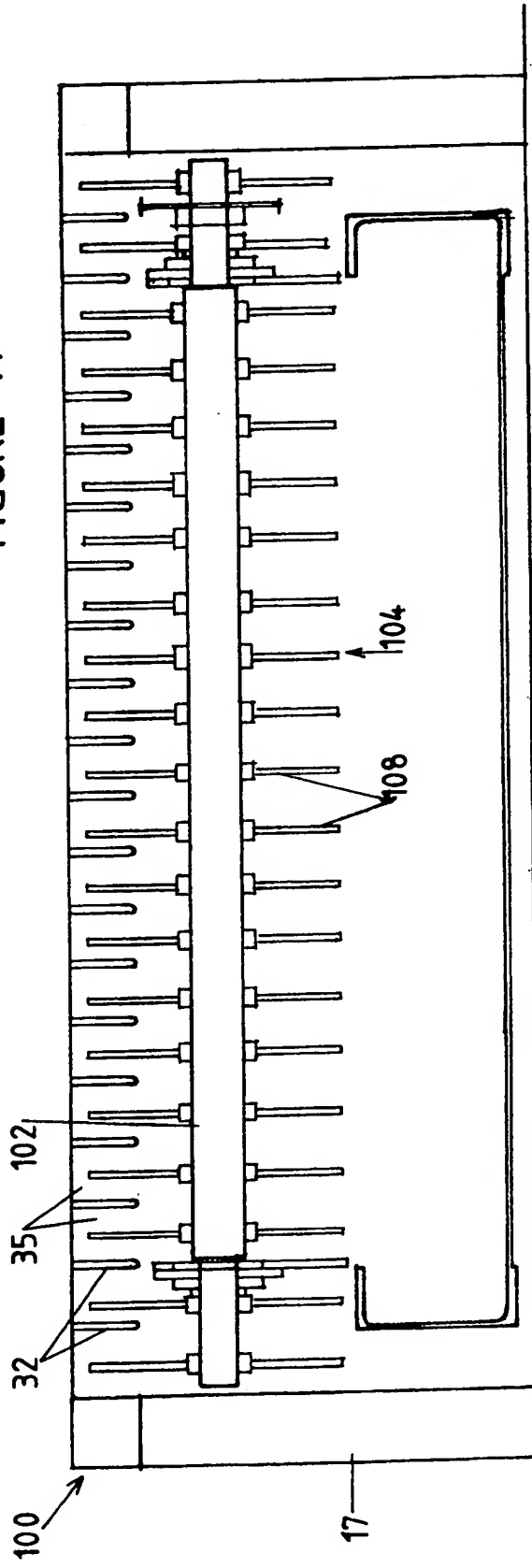
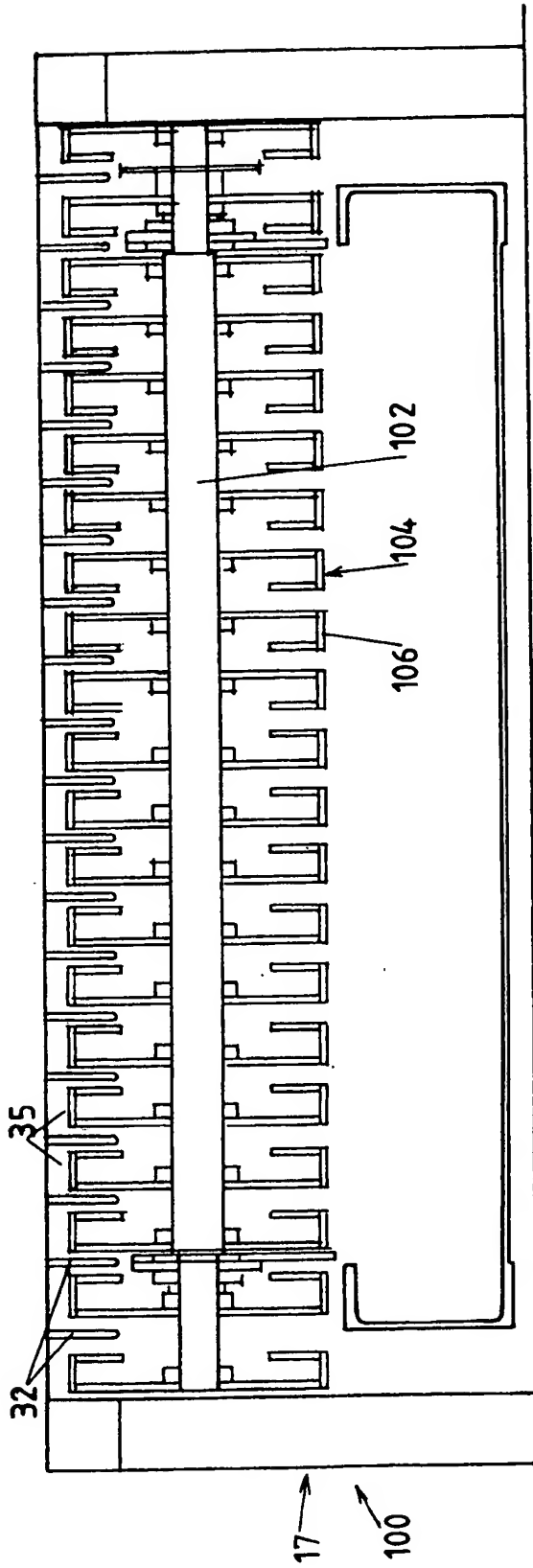


FIGURE 10







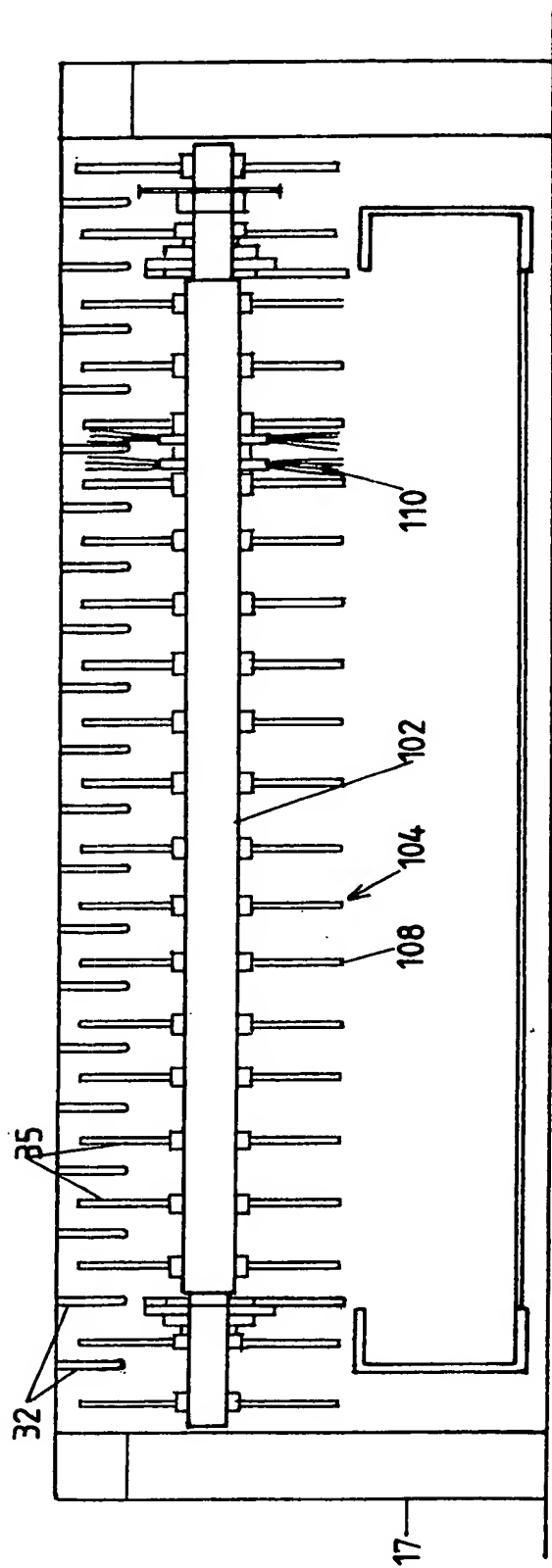


FIGURE 19

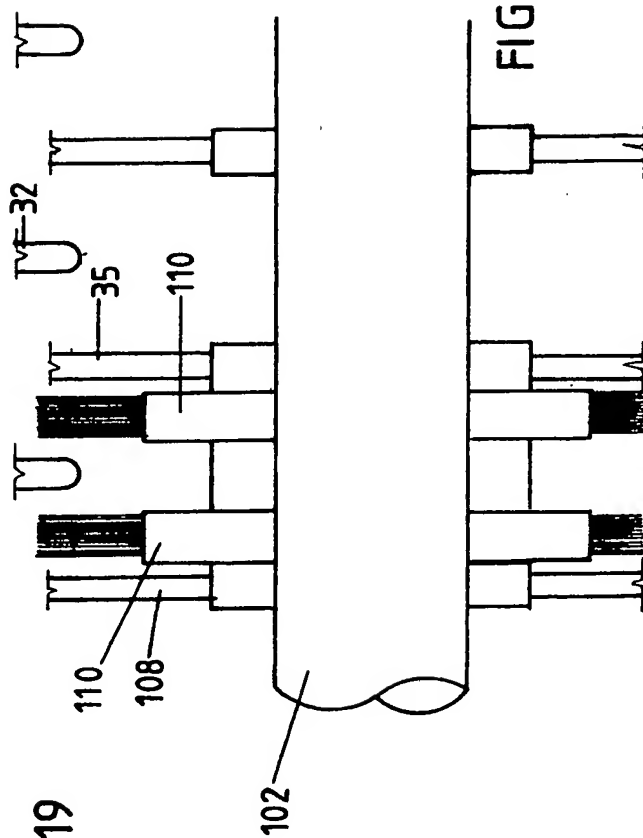


FIGURE 20

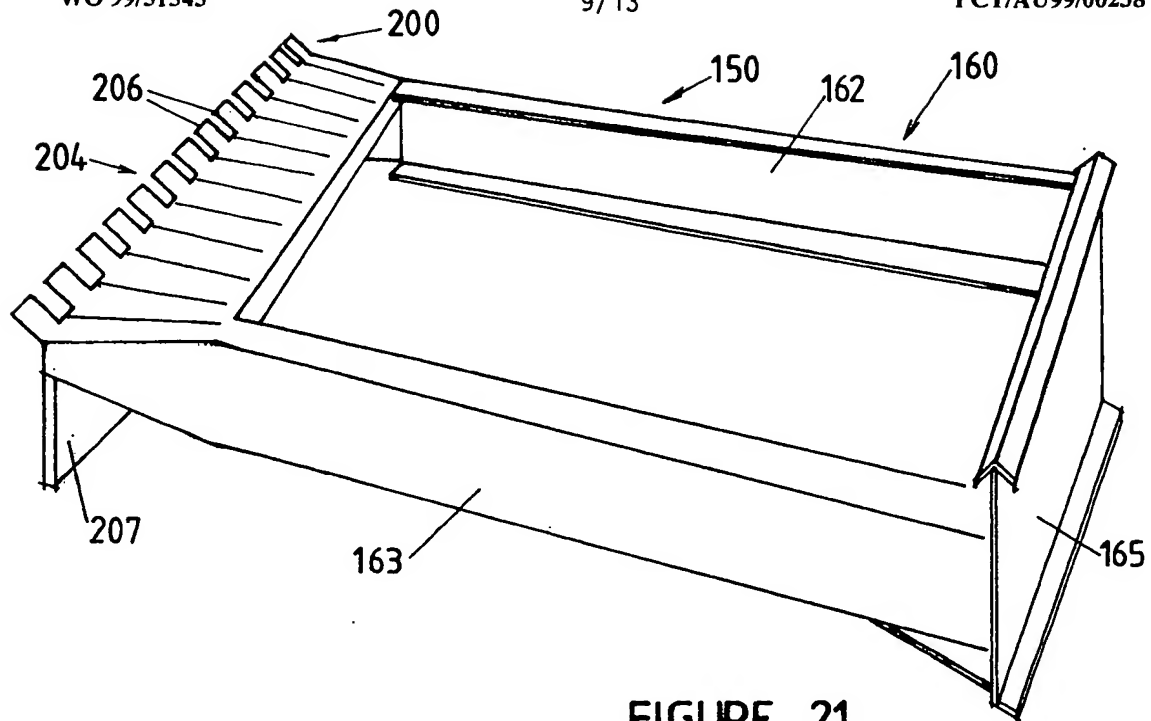


FIGURE 21

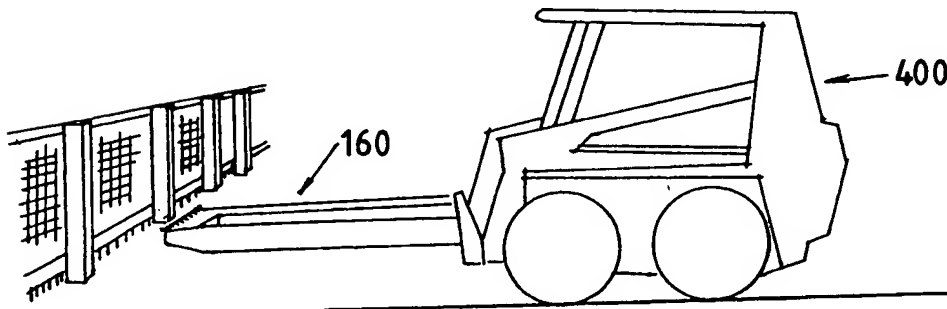


FIGURE 22

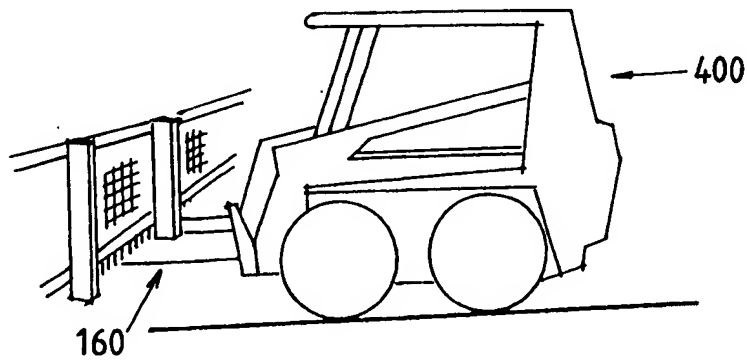


FIGURE 23

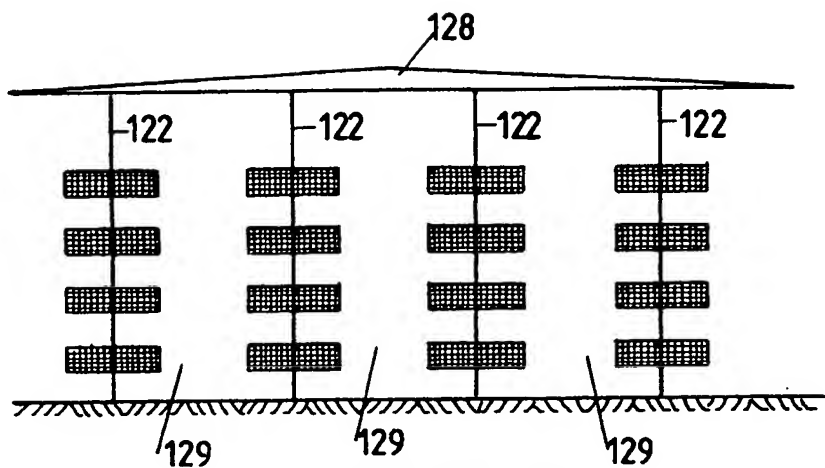


FIGURE 24

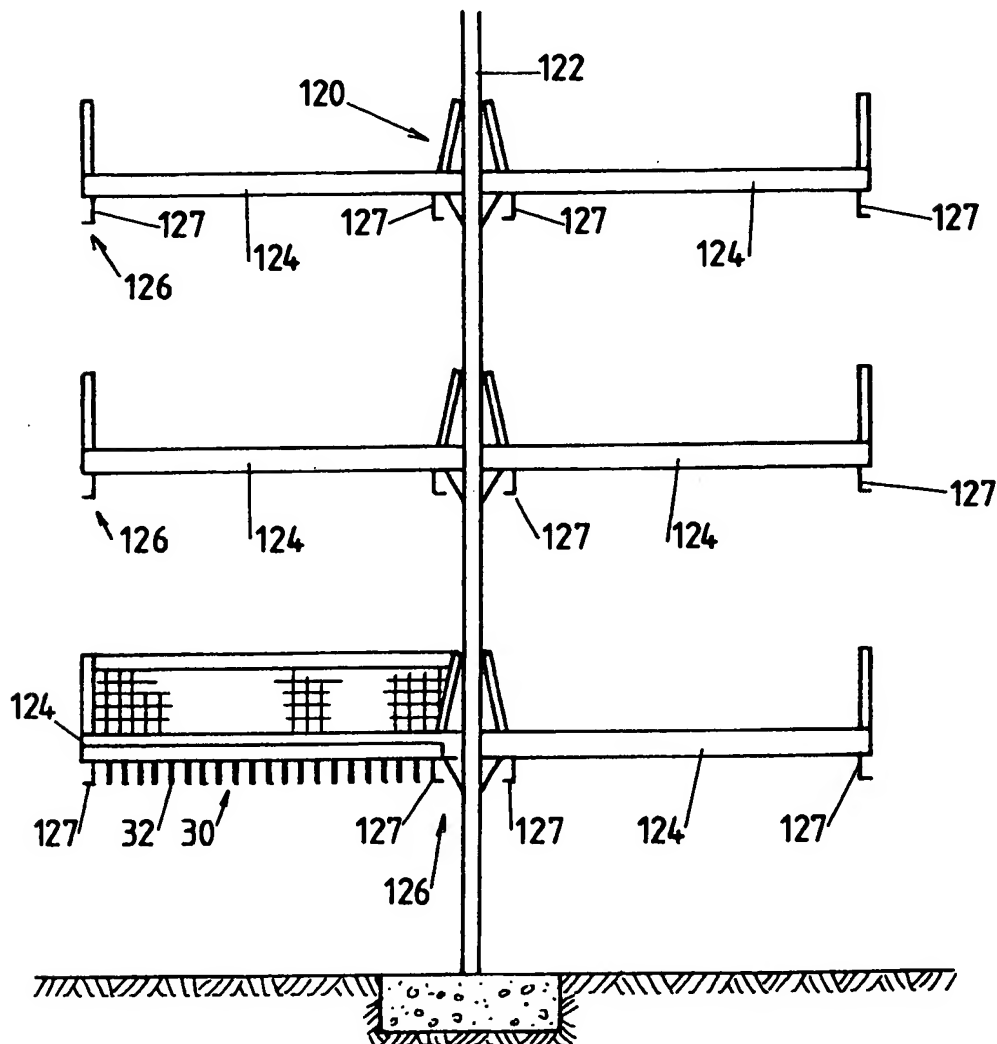
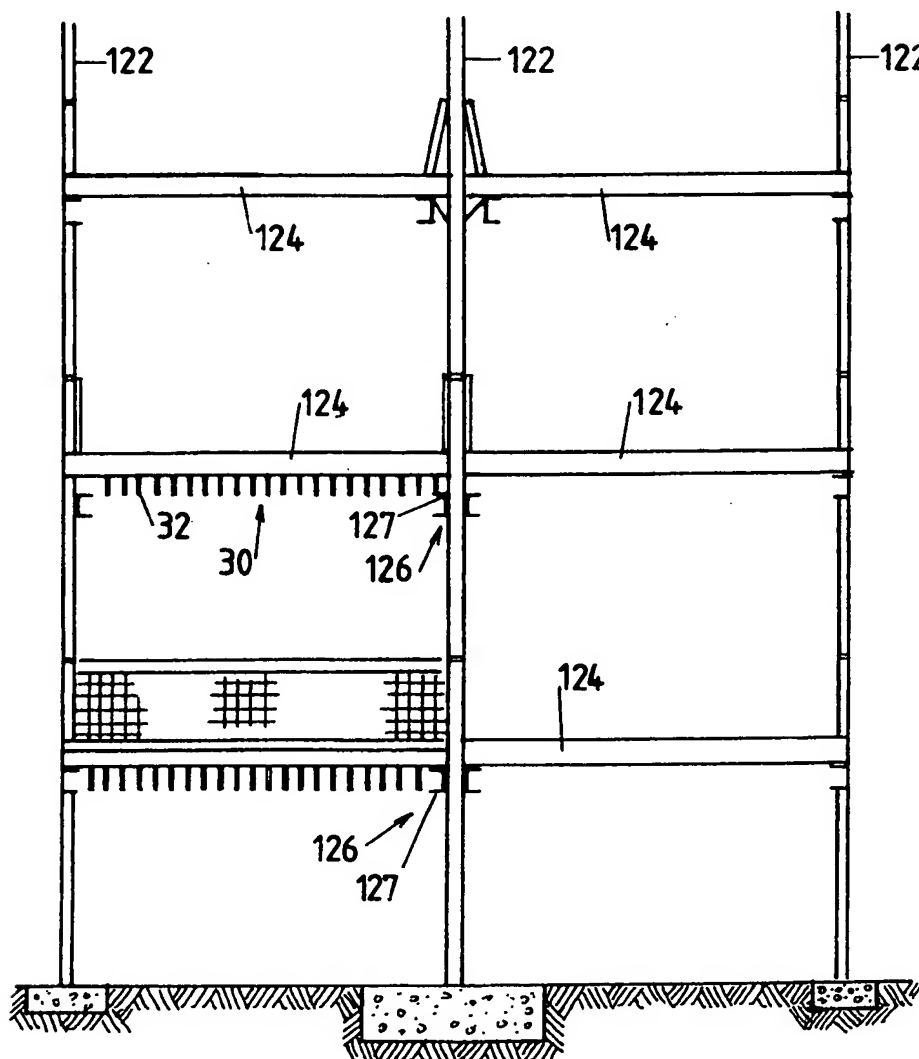
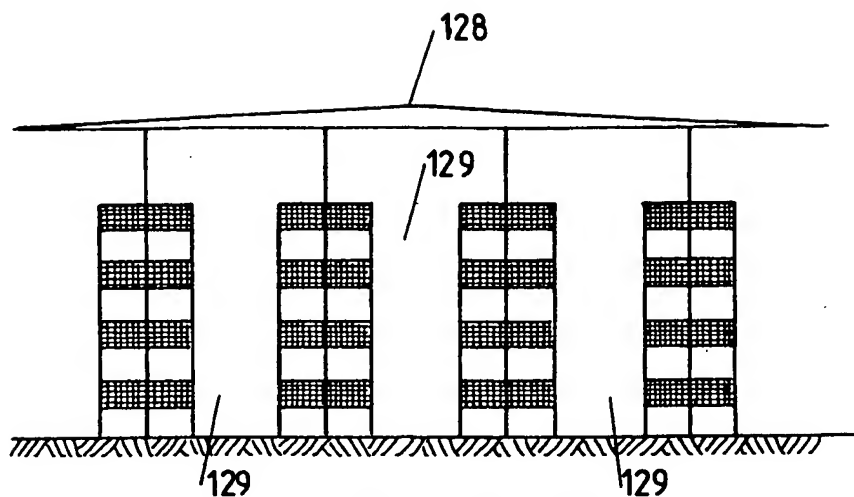


FIGURE 25





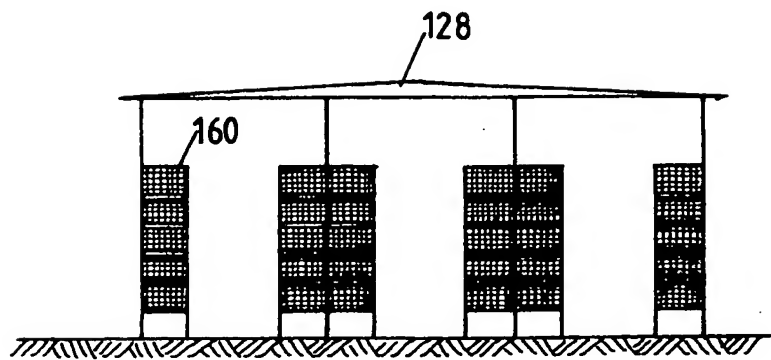


FIGURE 28

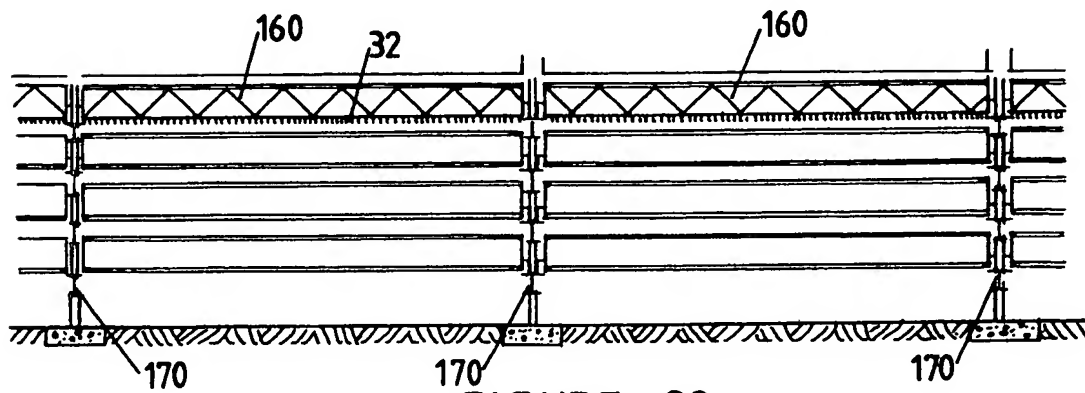


FIGURE 29

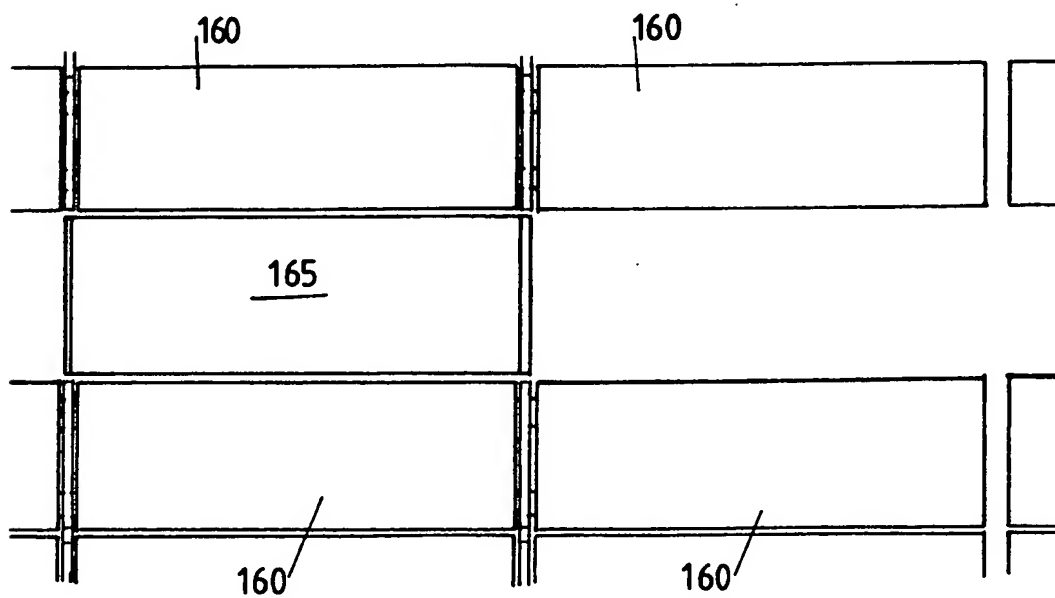


FIGURE 30

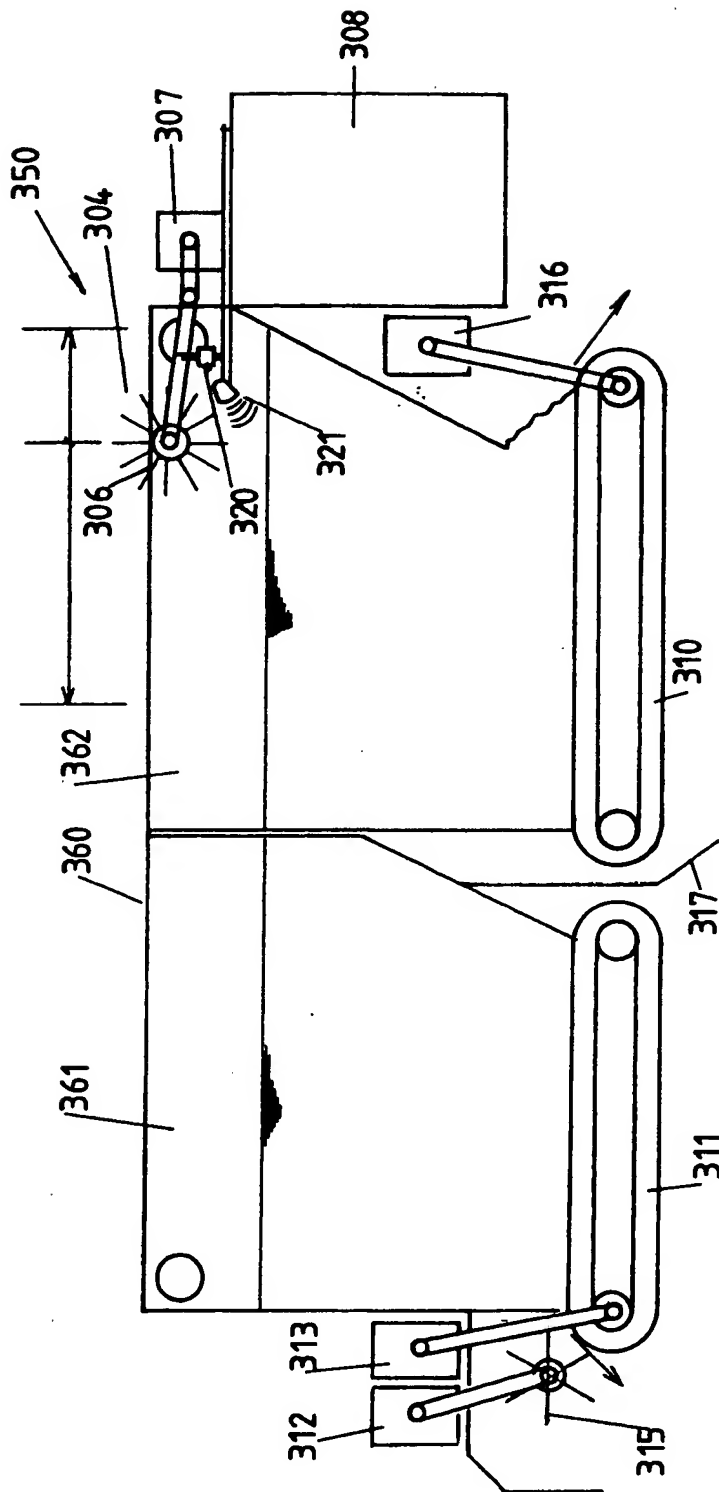


FIGURE 31

# INTERNATIONAL SEARCH REPORT

International application No. —  
PCT/AU 99/00238

## A. CLASSIFICATION OF SUBJECT MATTER

Int Cl<sup>6</sup>: C05F 9/02, 3/04, 17/02, C02F 11/02, A01K 67/033

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)  
IPC as above

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)  
WPAT, JAPIO:IPC and keywords

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 5527373 A (CHAREYRE) 18 June 1996 Column 5 line 50 - column 6 line 2, Figures 1-3	1-36
X	CA 2170294 A (EGGEN) 27 August 1997 Page 3 paragraph 3, Figure 5	1-21, 29, 32-36
X	GB 2211062 A (HYMAN) 28 June 1989 Abstract and page 3 last paragraph.	1-21, 29

☒ Further documents are listed in the  
continuation of Box C

☒ See patent family annex

### Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance  
"E" earlier application or patent but published on or after the international filing date  
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"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone  
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"&" document member of the same patent family

Date of the actual completion of the international search 13 April 1999	Date of mailing of the international search report 21 APR 1999
Name and mailing address of the ISA/AU AUSTRALIAN PATENT OFFICE PO BOX 200 WODEN ACT 2606 AUSTRALIA Facsimile No.: (02) 6285 3929	Authorized officer  M. BREMERS Telephone No.: (02) 6283 2052

# INTERNATIONAL SEARCH REPORT

International application No. —

PCT/AU 99/00238

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	EP 196887 A (NATIONAL RESEARCH DEVELOPMENT CORPORATION) 8 October 1986 Claims	1-20
P,X	EP 887328 A (TAYLOR et al.) 30 December 1998 Column 2 line 58 - column 4 line 1	1-20

## INTERNATIONAL SEARCH REPORT

### Information on patent family members

International application No. —  
PCT/AU 99/00238

This Annex lists the known "A" publication level patent family members relating to the patent documents cited in the above-mentioned international search report. The Australian Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

Patent Document Cited in Search Report				Patent Family Member			
US	5527373	CA	2028333	EP	425397	JP	3183679
EP	196887	GB	2174079				
EP	887328	GB	2326638				
END OF ANNEX							